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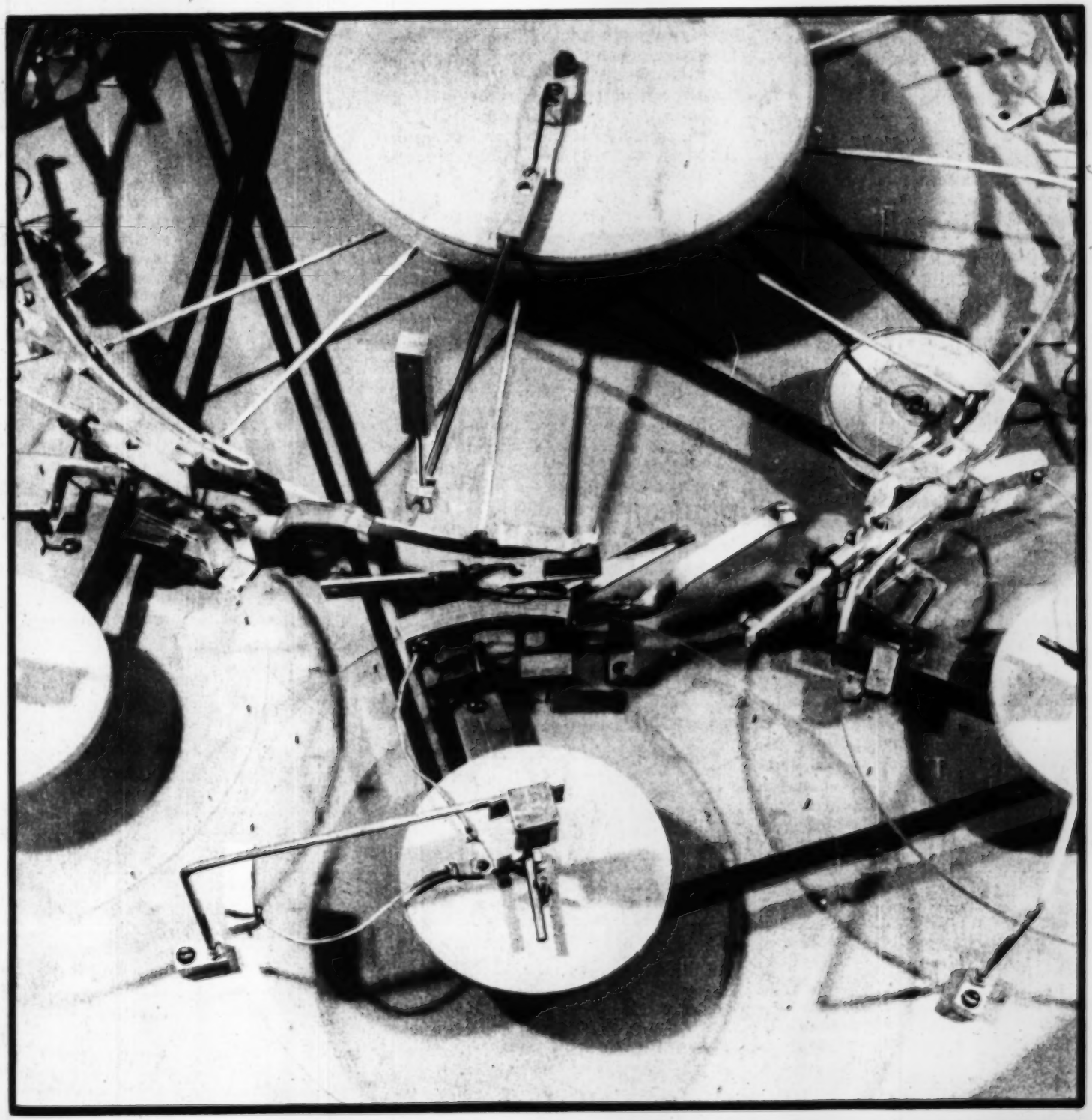
THE Journal OF INDUSTRIAL ENGINEERING

September 1949 Vol. 1 No. 2



EDITOR'S PAGE

What Do Industrial Engineers Do?

The Industrial Engineer makes surveys of how industrial plants or businesses are organized and operated, and on the basis of such studies he prepares recommendations to executives for changes in the way things are made or in the set-up of the firm that will lead to better use of employees, machinery, and money in the conduct of business. He may examine and observe how equipment and how men work, make time and motion studies, study production records and products, or talk with management and production personnel. He tries to obtain a comprehensive view of any plant or business activity such as: planning and scheduling of production; production methods, standards, equipment, cost records, and control; how materials and goods are received, packed, and shipped; the hiring, training, and management of personnel; wage payment system; relation of unions to management; the system for purchasing materials and supplies; the advertising and distribution of products; and the manner in which the business is financed. He may be called upon to plan a complete reorganization; a consolidation; or to develop a design, lay-out, and organization plan for a plant or business which is to be established.

Many industrial engineers, especially consultants with long training and experience, are qualified to survey and advise on all phases of a business or industrial organization. Most of them work in a particular industry, such as an electric utility or a chemical process industry, and deal with a particular broad phase of industrial engineering work, for example, plant design and construction, plant production, sales and marketing, purchasing, personnel and labor relations, wage systems, finances, or traffic management.

Editor: The above statements were adapted from OB No. 19, NRSSP of WMC.

MANUSCRIPTS SOUGHT

The editorial board of this Journal is desirous of receiving manuscripts about technical subjects of interest to industrial engineers.

ABOUT THE PRODUCTION OF THE JOURNAL

An explanation is due our members, subscribers and advertisers for the lateness of this issue and the fact that it could have been done better, although it is a big improvement on the first issue. The agency employed to do the layout work was sold out to another company. This resulted in our receiving back in headquarters a mass of page proofs, not fully complete, but too far along to permit of much changing. Although done by the same person, the strain of working for a company that could not offer security showed up in a poorer quality of work than that previously obtained.

Better things are in store! The Journal has been enough of a success that is has now attracted the attention of an experienced magazine publishing firm and arrangements are being made that will produce a great improvement in the next issue, and at no extra cost.

ADVERTISING

In this issue we are launched on the policy of carrying ads to help finance a bigger and better magazine than could be handled by dues revenue alone. Every member is urged to aid in selling space. It is a good bargain, because rates are low in keeping with our present limited circulation, (which is about 4000 copies). By contracting for space for a year companies are benefiting from the increasing circulation and readibility without increase in charges.

Write to headquarters for rate sheet and contract.

ELECTION PLANNED

Plans are now being made to conduct an election by mail in accordance with the constitution at an early date. At this stage in our development the Board of Trustees has the responsibility of functioning as the nominating committee. After there are at least three vice-presidents they will become the nominating group. It would be very helpful to have suggestions from the chapters or from individual members concerning suitable nominees.

(Continued on page 20)

A.I.I.E HONORED

On Wednesday, October 26th, the National Headquarters of the American Institute of Industrial Engineers was honored by a visit by Dr. Lillian Gilbreth.

Needless to say, those who had an opportunity to hear her speak and to visit with her individually at lunch were thrilled to have this contact with the beginnings of industrial engineering. The names of Taylor, Gantt and Gilbreth have become legendary and it seemed odd to hear them spoken of as familiar contacts.

In spite of her absorbing interest in the application of industrial engineering principles to problems of home economics Dr. Gilbreth maintains a lively interest in all other phases of the profession and expressed her pleasure to learn that the IE's own professional technical organization has been established and is growing so rapidaly.

A group of the older members propose to submit her name for election as our first "Fellow". Of course it is the association that would be honored by such an election, but Dr. Gilbreth was so gracious as to say that she would feel honored.

Professor Livingston's article explaining this chart will be found on page 14.

PERCENTAGE DISTRIBUTION OF POINTS IN INDUSTRIAL ENGINEERING CURRICULA BY FIVE MAJOR CLASSIFICATIONS

Industrial Engineering

	Min.	Av.	Max.
Basic Sci.	21	24	32
Basic Engr.	20	30/54	45
Ind. Engr.	6	17	24
Business	2	7/24	15
Humanities, etc.	15	22	31
		100	

Mechanical Engineering

	Min.	Av.	Max.
Basic Sci.	17	24	30
Basic Engr.	29	43/67	53
Ind. Engr.	6	11	16
Business	0	4/15	9
Humanities, etc.	7	18	26
		100	

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Editor-in-Chief
F. F. Groseclose, Director
School of Industrial Engineering
Georgia Institute of Technology

Assistant Editor
W. D. Jones
School of Industrial Engineering
Georgia Institute of Technology

Production & Business Manager
Wyllys G. Stanton
Department of Industrial Engr.
The Ohio State University

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The Cover-

A Machine Interference Computer Constructed by Professor Jones

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Rates and space information on application from National Headquarters. This Journal goes to a select list and the rates are low, making a very good value for advertisers with products of interest to engineers.

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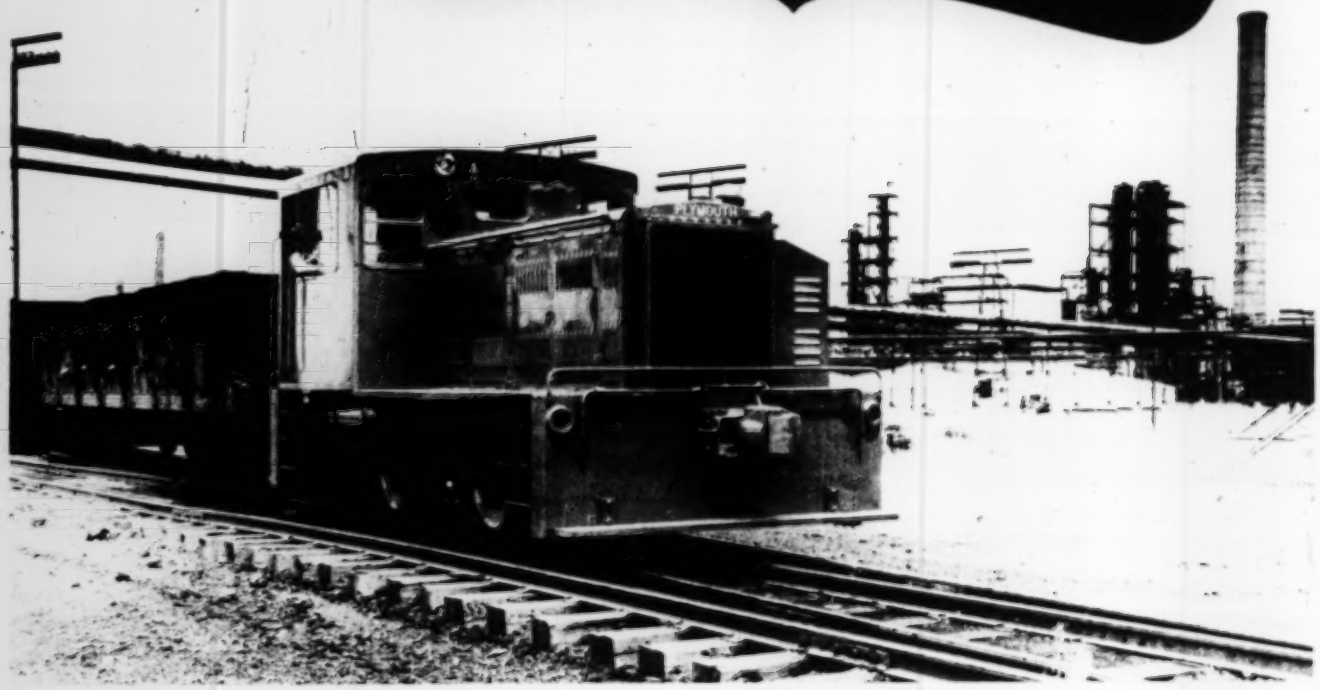

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PRESIDENT'S MESSAGE

With this, our second issue of the Journal of Industrial Engineering, we believe it entirely fitting that we review our progress during the past year.

Our total membership which was approximately 200 a year ago has now increased to 1600 and we have five active city chapters in operation located in New York, Cincinnati, Columbus, Dayton, and Jamshedpur, India. Additional city chapters are being organized in Boston, Cleveland, Philadelphia, Pittsburgh, Atlanta, and Rochester.

Letters were written to a number of Ohio Senators and representatives which helped in obtaining the passage of Ohio Senate Bill 329. This bill was sponsored by the Ohio Society of Professional Engineers for the purpose of amending the law providing for registration of Professional Engineers and Surveyors in Ohio. Had it failed to pass the act would have been declared unconstitutional in connection with a pending law suit for enforcement.

Representations have been made to the Board of Registration of a state which does not recognize industrial engineering. To name the state might interfere with negotiations which are in progress. Preparations are being made for a continuation of the nation wide survey of conditions of registration of industrial engineers.

We are now in correspondence with the Survey Committee of the Engineers Joint Council to induce them to list Industrial Engineers separately from all other branches in making their surveys. We have been successful in inducing the Bureau of Labor Statistics to list Industrial Engineers separately in their surveys and publications.

Every professional man should maintain a connection with his technical society. The American Institute of Industrial Engineers is our technical organization. It cooperates with the National Society of Professional Engineers which works on matters of legislation and public relations affecting all branches of engineering, and it works directly on all matters of particular interest to industrial engineers, but less important to members of other branches. Increased membership will bring increased strength. To increase membership is everybodys job.

PAST PRESIDENT'S KEY

Anticipating that some chapters may want to honor their officers on the completion of terms in office, special key designs have been obtained as illustrated above. Suggestions for alternate designs will be welcomed. These are based upon applying the present membership pin to a more or less standard background. In this manner it is possible to obtain a fine key at a reasonable cost. These keys will be made up only on special orders paid in advance by the chapter, prices are reasonable and will be quoted to chapter secretaries.

REPORT FROM NATIONAL HEADQUARTERS

Because it is still impossible to establish chapters in many parts of the country, there are many members who wonder what is happening at the national level in their organization. The only contact they have is when they receive a copy of the Journal, or have correspondence with the secretary. Under these circumstances some of them wonder if it is worth while to go on.

Definitely it is! The idea of having an association of Industrial Engineers on the professional level is so sound that letters are received each week from men who have heard of the Institute and wish to join.

There is much that the headquarters does that helps the position of all IE's that cannot be detailed in a publication. For example, during the summer correspondence with the Bureau of Labor Statistics had a part, at least, in the decision of that agency to change from listing the IE branch as merely an afterthought, treated in a couple of paragraphs under ME's in an important publication, to giving them separate treatment in the table of contents, and a chapter of their own.

Another item is correspondence with a state board of registration where it is impossible for a man to be registered in the IE branch. Progress is being made in convincing them that IE is really separate and important in its own right, and that it is not fair to require IE's to get registered as Mechanicals or Electricals.

During the summer a number of new chapters were established, in two cases the secretary traveled to attend the meetings. Day to day maintenance of the records, passing on new members, putting out the journal, including advertising solicitation, also take up a lot of time.

Thus it should be apparent that gains are being made, although it will take a long time to accomplish some of our goals. It is hoped that our members will look up on their connection from the point of view of what they can contribute, rather than merely from that of what they have gotten out of it. Also, that they contribute merely by being members until such time as it is possible for them to serve in some additional ways.

Wyllys G. Stanton.

NOTE TO EDITOR:

Dear Mr. Editor:

All during the war, John W. Nickerson and others fought to get rid of time-study prohibitions in the Army and Navy Appropriations Act. These were written in way back when F. W. Taylor was investigated.

Now there is a chance that an amendment will be tacked on that is even worse than the old one. A copy is attached. Don't you think that is vicious?

My proposal is that you write a stinging Editorial. You might point out as I have to some Senators that we applaud the Hoover approach to relief from taxes. Then we prohibit efficiency in Army and Navy. One Senator said it was to be limited to government employees. I replied that all of us were government employees in the last war.

Why shouldn't we get the most defense we can for our tax dollars?

PHIL CARROLL

A copy of the ammendment about which Mr. Carroll writes will be found on page 16. It is certainly a vicious attack upon all that Industrial Engineering stands for. Write your Congressman and Senators a protest against all such legislation. It is idle to say that it is limited to the effect it will have upon governmental employees. If this is put in for them it will soon be found reflected in all contracts for goods or services for the government, and may also crop up in the regulations of the Department of Labor and so become the standard for all employment.

Material Handling for Job Shop Production

by John W. Brantner

A recent survey of 120 diversified manufacturing plants shows that an average of about 36 cents of the production dollar was being used for the handling of materials. Even allowing for the fact that many handling movements cannot be eliminated there still exist a multitude of opportunities for improving handling methods.

Perhaps the most difficult handling problems are to be found in the intermittent and the semi-repetitive type of industry. Here the basic problems of material handling are further complicated by the inherent variety of products, small lot sizes, fluctuating work loads and many other problems to which the job shop is subjected. Through careful engineering good materials handling can be effected in these industries, however, and even though continuous handling in most cases is impractical if not impossible, the basic principles of continuous handling may be used as the criteria for developing a practical and efficient system.

DESIGNING HANDLING SYSTEM FOR A NEW PLANT

Recently, space requirements forced the relocation of a high production shop of this type. In addition to the move, a new equipment layout and materials handling system were put into effect. The basic principles of materials handling were followed in the design of the new system. Although the problems encountered here may not have an exact duplicate in other industries, they will serve as an example of how materials handling in the intermittent or semi-repetitive types of production can be put on a highly efficient basis.

PRODUCTS: This unit of the plant produces two basic products, pins and bushings. The pins range in size from 1/4 inch to 2 inch in diameter, from 2 inch to 19 inch in length, and have heads that are approximately twice the diameter of the shank. These pins are made with various types of shoulders on the shanks adjacent to the heads. In general, the bushings are hollow cylinders ranging in size from 1/2 inch to 2-3/4 inch in diameter and from one inch to seven inches or more in length.

THE PROBLEM: Although the problem in general is simply to manufacture the two aforementioned items, it is complicated by the fact that these items are produced in various grades or quality, in many sizes and styles, are made of several different metals and are manufactured to customer's specifications. About 1200 different parts are manufactured in all, being produced in lots as small as three or four and as large as several thousand pieces of the same item. Often, thirty or more different orders may be in process in this shop at the same time.

Mr. Brantner is a native of Columbus, Ohio, and is a Registered Professional Engineer. After graduating from Ohio State in 1941, he went westward to take a position with Basic Magnesium, Inc., Las Vegas, Nevada. A year later he joined the U. S. Navy as an officer on submarine duty. Four years later he took a position with Robins Conveyors, Inc. in Chicago, and later joined Jeffrey Manufacturing Co., Columbus, Ohio, where he is presently employed in the Industrial Engineering Department.

The manufacturing processes used are relatively simple. The pins are either formed directly from coil stock on a cold header or are cut off from bar stock on 4-spindle vertical cutoff machines, and then heated and headed on a hot forging machine. Various drilling, grinding and milling operations are then performed according to type and quality of pin. Bushings are made from bar stock, being drilled, reamed, chamferred on one end and cut off on 4 or 8-spindle automatics. The bushings are then chamferred on the other end, ground, drilled and/or milled according to the type or quality.

ATTACKING THE PROBLEM: In order to attack the problem, a rather comprehensive study of existing routings was made. These routings were then grouped and indicated on a flow diagram. This flow diagram was carefully studied to discover flow patterns in the existing processes. Any item which did not conform with one of the flow patterns was individually studied to determine if routing changes could be made to cause the processing to conform to the general patterns previously determined. Wherever this was possible, changes were made in the routing, and the new flow path charted.

Study of the revised chart revealed a fairly well defined flow pattern and on this basis a preliminary machine layout was made. The general order of machines and work areas was established by setting machines so that:

1. The shortest transportations between machines were obtained.
2. Back-tracking was kept to a minimum.

With the revised flow diagram and the preliminary layout avzilable, it was now possible to make a decision as to a handling system. Any system selected had to meet the following conditions:

1. Provide for movement of pieces with a minimum of manual work.
2. Allow flexibility so that a given lot could be conveniently stored between operations and any lot readily removed from storage and shifted to the next machine or work area.
3. Routing must be possible from any machine to any other machine or work area.

After considering several different types of handling systems, it was decided that a roller conveyor system would provide the best answer to the particular problems. There were, however, several obstacles yet to be overcome. Although a stationary roller conveyor could possibly be used through the primary phases of manufacture, the flow became so complex after these first few operations that a stationary roller section was shown to be impractical. This problem was solved by providing a battery powered high lift truck, shown in the accompanying illustration, equipped with several short sections of roller conveyor. When used this stationary roller conveyor at the individual machines this scheme provided the equivalent of an infinite number of roller paths interconnecting all of the machines used in the process.

(Cont'd next page)

(Cont'd from page 6)

A second problem to be solved was the discontinuity of flow after the starting operations. In the case of making bushings, for example, the first operation on the automatics was continuous, while subsequent operations were most irregular and were, for the most part batch type. This was solved by providing surge areas, as illustrated, at various strategic locations throughout the plant large enough to accumulate several complete orders.

The problem of a container was also studied at this time. There were several considerations involved in the selection of a container:

1. It must be of a size that could be easily handled when empty, easily rolled along the conveyor when full, and contain enough parts to provide a reasonable run at each operation.
2. It must be of such shape as to roll freely on the conveyor, stack for easy storage and handling with a hoist where necessary.

A tapered nesting tote pan of about 2.5 cubic feet capacity was selected.

It should be noted here that a few of the products manufactured in this plant are of a size and/or shape which makes it impossible to handle them by the system described herein. These products, however, are so few and are made in runs of such short duration that they can be handled conveniently by other methods and it was not felt that they should be considered in the overall plan of the system.

Loading ground bushings from grinder to battery powered high lift truck, on which they will be transported to the next operation.

With the above decisions made, it was then possible to review the routing and layout together with the handling system planned and arrive at a final layout. The machine position, the routing, or the handling system was adjusted where necessary to achieve the best overall result.

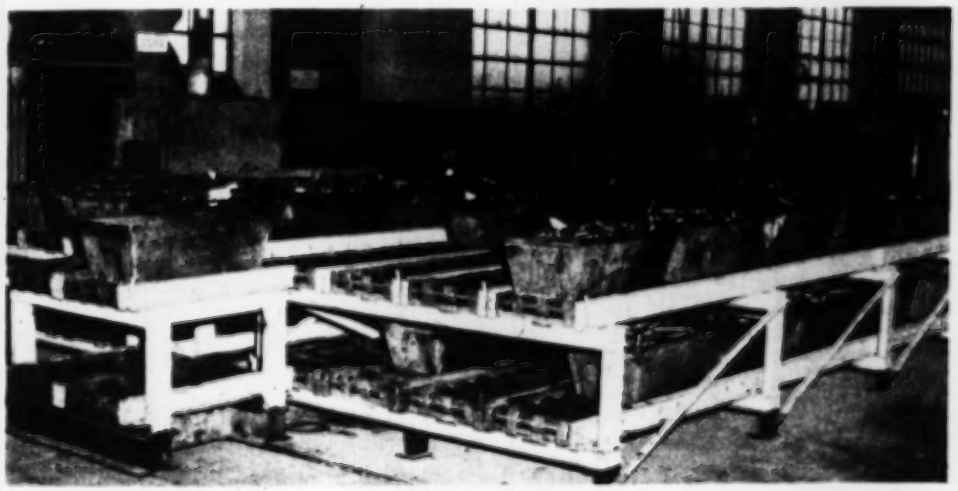
THE COMPLETED PLANT: In the finished plant, steel is delivered into the manufacturing area by means of a monorail system. The steel is placed in racks at the head of the line from whence it is picked up by floor operated hoists and delivered to each machine as needed. Approximately two orders for each machine are stored in advance in these racks.

After the bar stock has been cut off on the automatic cutoff machines in the pin line the pieces are washed, deburred, and put into a surge section waiting to be delivered to a hot forging machine. The pins which are cold headed from coil stock are also washed and sorted in this area. From this surge section, the parts proceed either to the hot forging machine or to the tempering furnace. Then they are again placed in a general surge area which serves both the pin line and the bushing line.

The bushings are brought to this same area after coming from the automatics, being weigh-counted, washed and deburred. This general surge and sorting area is made up of double deck conveyor sections as shown in the accompanying illustration, work arriving on the lower level and being sorted on the upper level after washing. A hoist is provided in the line for changing elevations.

Beyond this point, all machines are fed by means of the battery operated truck equipped with roller sections. The high lift feature of this truck permits better utilization of the double deck storage section and delivers the parts at a height most convenient for the machine operator. Each machine in this group is provided with two roller sections, one for receiving parts and one for finished work. Each section is of such a

(Cont'd on page 17)



A view of the general surge area showing one of the transfer cars which serves both sides of this section. A hoist is provided in the line for changing pans from the lower level to the upper level.

Role of the Industrial Engineer in Creating Industrial Peace

Wilson J. Bentley

The Industrial Engineer possesses a "pass-key" to the door of industrial peace: This door has been opened few times in the last decade, so its hinges are rusty and the lock difficult of operation. But, a knowledge of the operation of the lock and constant oiling of the hinges can result in the door swinging wide again. The rust is the resistance of people in different industrial strata to working together. The lock on the door is the lack of understanding of the human problems of the wage earners and the mechanical and economic problems of management.

The unlocking of this door can best be performed by the person who happens to be in a position which affords the closest contact with the existing human, mechanical, and economic problems, and who has the intelligence, personality, and desire to accomplish industrial peace.

To find the category of plant personnel which best satisfies the foregoing description, we have but to consider the Industrial Engineer and his job. Here is a man, who in the normal course of his work, moves all through the plant. Today, he may be dressed in overalls and a pair of rubber boots, spending half-day with a worker who has the most unpleasant job in the plant. Tomorrow, he may be dressed in a smart business suit, appearing before the production planning committee, or the Board of Directors of the company. Next, he may be found in the conference room conducting a foreman's training conference, or possibly, discussing plant payrolls with the company auditor. Or perhaps, he will be found in the plant cafeteria buying coffee for two or three workers and explaining a production rate he has set up for them to attain. All these activities, remember, are in this man's normal work areas. What man has a better chance to have close contact with the human, mechanical, and economic problems than the Industrial Engineer?

Happiness depends largely upon understanding. His position places the Industrial Engineer in a perfect spot to explain company policies to the workmen, as well as the human problems to the management. People must know and understand the rules by which they live and work or they feel there is no security for them.

Mr. Bentley was born in Oklahoma. After securing a degree in Industrial Engineering at Oklahoma A & M College in 1939, he spent five ane one-half years in the Combat Engineers as an Army Engineer Officer and as an advisor to Chief of French Engineers on American Engineer Material. Later, he joined Wilson & Company, meat packers, where he was employed three years as an Industrial Engineer in the Planning and Methods Department. He is now a Registered Professional Engineer and an Instructor in the School of Industrial Engineering at Oklahoma A & M College.

Whether it be the economic philosophy of Karl Marx, or Socialism, or Capitalism, the philosophies are all based upon full production. We can say that the Industrial Engineer is the creator of full production. And, in turn, full production can be a creator of industrial peace. He has the daily contacts with both labor and management and normally will have the intelligence and personality to instill trust in the sentiments of both these parties. By his persuasive power, his dissemination of information and education, and his understanding of the human problems as well as the mechanical and economic problems, he has the opportunity to be one of the greatest aids to industrial peace.

Walter W. Cenerazzo, President of a Watch Workers Union, set up a good standard for present and future Industrial Engineers when he stated, "I believe that . . . . . the Industrial Engineer must make himself a warm, human person, the type of person who can be understood by others. I have worked with time study men who had more influence in a job than any union steward or foreman, because he could sell himself to the people and sell himself to the people working on the job. That is the kind of Industrial Engineer we need more of.

In this age people seem to have an inborn distrust of any person they have neither seen nor heard. This is probably one of the reasons why our presidential candidates attempt to be seen by a maximum number of voters before an election. For top management to be trusted it should have a spokesman, or interpreter, whom the wage earners see and whom they know is mentally honest. The Industrial Engineer can establish for himself a reputation of complete honesty and fairness by adopting a high code of ethics. This code of ethics should be followed whether he be checking a production rate or investigating a petty grievance. Mental honesty in his work will need little paid advertising as the union soon discerns which man can always be depended upon to recommend a fair solution to all problems. Adherence to such a code of ethics will secure the confidence of the wage earner and management alike.

When an individual possesses the confidence of both union members and management, he is in a perfect position to disseminate education. The surest vehicle for education and information is the small conference procedure. Not only is this type of meeting a source of information, but in itself will foster better friendship and understanding among the personnel. The acceptance of education and information depends largely upon the respect felt for the instructor. The ethical Industrial Engineer will find this acceptance aided greatly by this factor of confidence. So much of labor-management difficulty stems from the lack of information! The present popular practice of many companies to try to inform the public by newspaper articles, after a strike is in progress, admits failure to give information where and when it is needed. Some strikes have stated that they had learned more than ever before about their company from the company letters and newspaper articles -- but too late.

Book Review - Management of an Enterprise

By Balderson, Brecht, Karabasz & Riddle
Second Edition 1949, 493 pp., Prentice-Hall, Inc.

Reviewed by Professor Donald B. Wilcox, School of Industrial Engineering, Georgia Institute of Technology, Atlanta, Georgia.

In this edition of their earlier text the authors have endeavored to present a new and logical arrangement of the topics conventionally included in the field of management. Addressed primarily to student as an orientation to the problems of business and industry, this textbook has little value for the practicing Industrial Engineer. The authors have spread themselves rather thin in an effort to encompass a very wide field of activity, and in many cases have used statements of broad generalities as illustrative of fundamental principles.

From the standpoint of teachability, this text has much to commend it for use in an introductory course. The discussion questions at the end of each chapter are conducive to arousing worthwhile discussion and constructive thought. The only regret of this reviewer is that there are not more of them. The authors have included a great many references to specific firms by corporate names which adds a note of realism that the average student appreciates and all too seldom finds in his textbooks. However, many of the illustrations are dark, gloomy old-fashioned photographs, detracting from the general appeal of the book.

Section I, devoted to the Fundamental Management Decisions, lays a sound basis for the following discussions on such aspects as Physical Facilities, Work Simplification, Product Design, Production Control, Budgets and Personnel. Outstanding among these are the chapters on Power and Setting of Selling Prices. Throughout the volume a consistent effort has been made to present all sides of controversial points and to illustrate the various alternative methods used by industries to tackle typical problems. The authors have included an excellent brief selected bibliography which is conveniently arranged by topics.

Robert E. Allen

Although the reviewer is inclined to dismiss this text as just another in the growing list of books treating the general topic of Business and Industrial Management, it must be admitted that a careful reading of this text will suggest new approaches to current problems and will broaden the horizon of anyone so close to the particular tree near which he happens to be working that he cannot see the woods.

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Machine Interference

by W. D. Jones

Machine interference needs no introduction to the wage incentive rate setter. He might describe it as a capricious, variable, unpredictable, immeasurable, spasmodic condition which provides eternal grounds for confusion when establishing incentive rates for products manufactured in multiple. To insure an understanding of the problem by all, however, machine interference will be taken to mean the idleness a machine experiences when it is non-productive and waiting to be serviced by the operator who is servicing another machine.

The effects of machine interference are particularly apparent in the textile industry, where each operator usually attends to several semi-automatic machines. For a given work assignment there may be times when all machines are running and the operator is merely waiting for something to happen. There are the many occasions involving machine interference, however, when varying numbers of machines chance to shut down simultaneously. In many cases there is little, if anything, that the operator can do to control the unpredictable shut downs of the machines and the consequent machine interference idleness.

The problem of evaluating machine interference losses is important to the engineer in two respects. First, machine interference loss must be known quantitatively in order to arrive at the economic number of semi-automatic machines to assign to one operator. Second, the operator's actual productive efficiency cannot be determined from wage incentive purposes until the loss of production occasioned by machine interference has been properly evaluated.

Countless hours have been spent by time study men in attempts to evaluate machine interference by use of stop watches. However, the unpredictable, variable shutdowns of the many machines involved in a given assignment make the job of recording interference time an almost impossible task. Moreover, the question always arises as to whether the period of timing was of sufficient length to be representative of the actual conditions of operation. Finally, as in regular time studies, it is always necessary to rate the varying productive efforts of individual operators. Because of the many variables

Mr. Jones is from Tulsa, Oklahoma. Upon receipt of his B.S. in Industrial Engineering, he joined R. C. A. where he was engaged in time study and methods work. Later he was employed as an Industrial Engineer at Selector Manufacturing Co., Wallace Clark & Co., Johns-Manville Corporation and E. R. Squibb & Sons. He is now an Assistant Professor in the School of Industrial Engineering at Georgia Tech. He now has a M. S. degree in Industrial Engineering and is a Registered Professional Engineer.

and uncertainties associated with the stop watch timing of machine interference, findings so obtained are generally little better than pure guess work.

It has recently been found through carefully conducted experiment that the laws of probability[1] provide a valid basis for evaluating machine interference idleness in cases where the running cycles of the machines tended by one operator cannot be coordinated. The simple formula which made it possible to construct the interference curves was derived as follows:

Let S = the normal servicing time plus allowance for fatigue, personal and minor interruptions, artificially assuming the machine on which the product is to be manufactured is to be individually tended from a point involving average walking necessary when all machines in the assignment are tended together.

Let R = the running time per unit of product. Then %s, the percentage normal servicing time to overall time when one operator tends one machine can be expressed as:

$$\%S = \frac{S}{S + R}$$

Let E = the operator's average productive effort, expressed decimally (100% ÷ 1.00), during the servicing duties.

Then $\%S_E$, the actual percentage servicing time to overall time when one operator exerts E productive effort when tending one machine, would be:

$$\%S_E = \frac{S/E}{S/E + R} \quad \text{or}$$

$$\%S_E = \frac{\%S/E}{\%S/E + (100\% - \%S)}$$

Let n = the number of machines tended by one operator.

When one operator tends n machines, machine interference becomes a factor in the operating disposition of each machine. Let %i = the average percentage of overall time each machine will be non-productive due to machine interference when one operator tends n machines, each requiring an average of $\%S_E$ percentage servicing time to overall time.

Then %s, the actual percentage servicing time per machine to overall time when one operator exerts E productive effort in tending n machines can be described as:

$$\%s = \%S_E\ (100\% - \%i)$$

where (100% - %i) is expressed decimally.
Let %4 = the average percentage non-productive time per machine to overall time when n machines are tended together; %d = %s + %i.

The probability of a given machine producing at a given moment is 100% - %d.

(Cont'd next page)

W. D. Jones, "A Simple Way to Figure Machine Downtime", Factory Management and Maintenance, October, 11946, pp. 118 - 121. This article presents a more involved approach to the problem of machine interference than the one described herein. However, both mathematical methods yield identical results for a given set of conditions.

(Cont'd from page 10)

According to the laws of probability, the probability of all n machines producing simultaneously at a given moment is $(100\%-\%d)^n$ where $(100\%-\%d)$ is expressed decimally.[2]

Similarly, the probability of one or more machines being down at a given moment is $1-(100\%-\%d)^n$ where $(100\%-\%d)$ is expressed decimally. It therefore follows that $\%s$, the average percentage servicing time per machine to overall time, expressed decimally, can be represented as:

$$\%s = \frac{1-(100\%-\%d)^n}{n}$$

Where $(100\%-\%d)$ is expressed decimally.

The above expression was used in constructing the accompanying interference curves. In preparing the curves, convenient $\%d$ values were chosen for various n values to compute $\%s$ values. Then, corresponding percentage interference, $\%i$, values were determined by substituion $\%d$ and respective by substitution $\%d$ and respective $\%s$ values in the expression $\%i = \%d-\%s$.

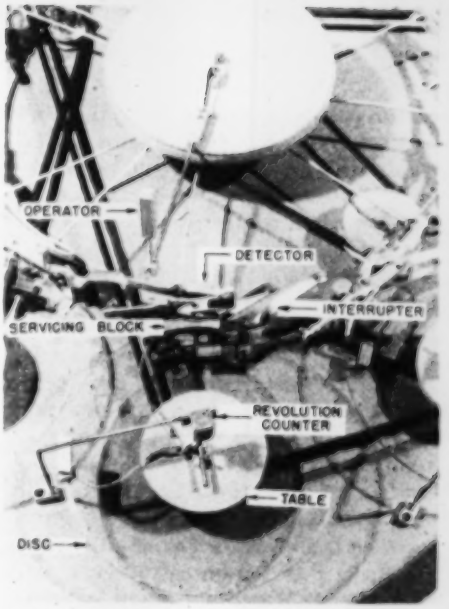
In its most convenient form the percentage servicing time per machine must be stated as $\%S$, i.e., on an individual machine attention basis. According to the previous definition of $\%s$; $\%s = \%S_E(100\%-\%i)$ or $\%S_E = \%s/(100\%-\%i)$. To determine the $\%S_E$ values used in constructing the interference curves it was therefore necessary to divide the various $\%s$ values by the corresponding $(100\%-\%i)$ values.

THE INTERFERENCE COMPUTER

The machine interference computer[3], shown in the accompanying illustrations, was developed to test the reliability of the machine interference curves for groups of ten or less machines tended by one operator. The equipment, which provides for the creation and accurate measurement of machine interference, consists of three components: (1) a group of ten "machines" placed in a circle, (2) an "operator" moving about the circle, stopping and servicing machines whihh shut down, and (3) a timing and revolution counting apparatus which gives the basic data necessary for computing the servicing time, running time and interference time of the machines for each test.

To date, more than 100 thirty minute tests have been conducted with the interference computer, giving results representative of approximately 500 hours of multiple machine assignment in the plant. The tests involved conditions of uniformity where the servicing requirements per machine were the same, as well as non-uniform conditions where the servicing requirements per machine varied considerably. The test results were in

(Cont'd on page 19)



The machine in the foreground has shut down and is waiting to be serviced by the "operator," thereby creating interference waiting time. The action of the operator will be to pass counterclockwise beneath the detector, raising it and then dropping it on top of the servicing block, thereby permitting the disc to resume movement (in a clockwise direction). In the raised position, however, the detector will detain the operator. Thus, "servicing" by the operator will continue until the servicing block completes its passage beneath the detector, after which the operator will move on to the next machine that is idle and awaiting hand servicing.

The interference computer set up for time-study laboratory practice. As a student attempts to time the running disposition of the several machines attended by one operator, he readily senses the problems confronting engineers in practice. In operation, the colored bulbs light when the machines need servicing, and the white bulb of an individual machine glows while that machine is being serviced by the operator.

[2] This statement is exactly true only in cases where the $\%d$ for each machine in the group is the same. However experiments on the "interference computer," to be described, have proved that in cases where $\%d$ differs for individual machines in the group, the use of the average $\%d$ in $(100\%-\%d)^n$ introduces an insignificant error.

[3] W. D. Jones, "Mathematical and Experimental Calculation of Machine Interference Time" The Research Engineer, Georgia Institute of Technology, January 1949. This publication can be secured without charge from the writer.

Building an Engineering Career

by Robert E. Allen

Lest you may have gained the impression from the title given in the program that you were going to be treated to a lecture on proper decorum for engineers when wearing top hat, white tie, and tails, let me set your minds at ease here and now. The kind of drawing room society enjoyed by most engineers does not require an Emily Post slide rule for guidance on social guidance on social conduct. I am very happy to be here tonight because it holds a special personal thrill for me. It is my first appearance on a program of this kind on the campus since I was graduated here some fifteen years ago.

Because we have so much in common in having attended classes in the same rooms, walked the same paths across the campus, made the same mistakes and got ourselves into the same jams, I would like to ask you to trade places with me for a moment and project yourselves about 15 years into the future. You have been invited to talk to the engineering students of your college and you are pleased as punch at the idea of coming back here. Many pictures of the events of your stay flash through your mind. You recall how Chief Younger used to bring a class to a close by refilling his pipe and a cheery "That's all fellows." How the leading lady in the Quadrangle Jesters show received a little too much spiritual help between acts and in the final act had to be led on stage between two stalwart members of the chorus. She sang better than she ever did in the rehearsals.

Suddenly like a chill wind the awful fact appears that you are supposed to hold the attention of a group of fellows like yourself for 20 minutes or so. Now what can you possibly say that will make sense or that they haven't already heard before. Of course, all the trite things about the value of hard work, character, honesty, integrity, etc., that you used to hear have been proved true by painful experience, but you can't expect them to be interested in that stuff. So here you are. By now, you are probably ready to trade places again and let me sweat this thing out alone. Since we both have discovered that I'm no public speaker, we'd better forget the idea of making a speech and spend a little time discussing a few common problems. As a matter of fact, problems that aren't too important at the moment, but which might become so in the future.

As we listened to the two previous speakers so interestingly describe two areas of engineering endeavor, I'm sure all of us were thrilled to be part of the engineering profession. Engineering is one of the few constructive professions. It relies not on illness nor misfortune for its existence but it brings to everyone a better life. Truly you can be proud to be a member of this great profession that embraces so many complex and specialized fields. In spite of the difference in the various branches of engineering, most of us have much more in common than we perhaps realize. All of our work is based on the same fundamental antural laws and all of it demands the same logical approach. The same type of approach can be applied to the design of a bridge as to the installation of a job evaluation plan. In fact, you may major in one branch only to find yourself practicing in another ten years hence.

I was particularly interested in the talk on prefabricated houses, for if there is anything that America needs more than a good five cent cigar, it is a good $5000 house. I'm sure all of us would like to own a nice new house with all the modern conveniences engineered into it. Now let's suppose Lustron, by mass production methods, is able to offer houses for $5000 and we somehow have enough money to buy one. Our first problem is to find a suitable home site. We want a good neighborhood, one that is building up in value and not a slum district. It must be well located with respect to shopping facilities and other conveniences. No matter how fine the house, if it is in a poor location it will not be attractive to future buyers. Let's say we have found our lot and have our home erected on it. Here we are with a well planned, well constructed home in a fine neighborhood. Is it finished? You may think so but your wife won't. Oh, no. It must have attractive landscaping outside, and curtains, draperies, carpets, pictures on the walls and all the incidentals that make it beautiful and distinctive.

Now let's take a look at this house we are building which we call a career. I am told that today you will have a minimum of $5000 invested in your engineering education by the time you are handed your diploma. If you have planned wisely and worked carefully, you have a sturdy structure on a solid foundation with all the room that is required for expansion and growth. It is well equipped with all the essentials for a happy and constructive life.

The engineering profession is a wonderful neighborhood in which to have built your house. It is progressive, favorably regarded by other members of the community and is constantly increasing in its value to society. Here is every opportunity for your career to flourish and develop. Look around at some of the other houses that have been built here. Some are indeed beautiful, but others seem to lack something. Here's one where the shrubbery needs trimming and the lawn needs a shave. There's another with excellent construction, but the interior is so bare and unattractive. An engineer from another company in Dayton made an appointment to see me recently to talk over a particular problem. When he appeared he had no necktie, he badly needed a shave, and his suit need pressing. He certainly stacked the cards against himself in making a first impression.

Unfortunately, too many of us are so engrossed in erecting the sound framework of technical training that we fail to see the need for planning the addition of things that will round out personalities and make us more attractive to employers and the public. I attended a meeting of engineers recently and found that none of them had the most rudimentary knowledge of parliamentary procedure. Many technical men seem totally ignorant of the workings of our modern society. Things are done by groups of people working together in the interest of a common cause. You cannot accomplish much alone. This may come as a shock to you but a large segment of the public today thinks of an engineer as a man who drives a locomotive. Our deeds alone are not enough. We must still sell ourselves to employer and public alike. Successful selling requires well planned advertising and attractive packaging even though the product is excellent.

You are fortunate in attending a school that has adopted the five year curriculum to give you an opportunity to round out your training with a few courses in the cultural and business fields. I urge you also to take full advantage of the training offered by extra curricular activities. Select one

(Cont'd on page 16)

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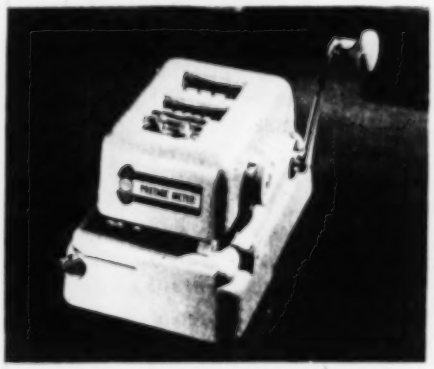
NEW DESK MODEL POSTAGE METER BRINGS METERED MAIL'S ADVANTAGES TO SMALL FIRMS

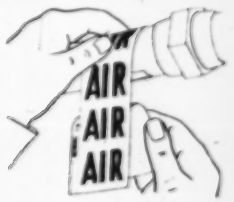


The first "desk model" postage meter, little larger than a dial phone, yet a complete metered mailing machine that stamps and seals mail of all kinds and classes, made its national debut this month in 86 branch sales-service offices of Pitney-Bowes, Inc. after six years' development and field testing.

By simply "dialing" the stamp value wanted and pressing a lever, the new baby postage meter prints postage of any value, complete with dated postmark and, optionally, the user's own advertising message, trademark or monogram. It accounts for postage used and postage on hand in visible, dollar-and-cents registers. A moistening machanism permits sealing of envelope flaps, and a detachable unit takes care of parcel post postage.

Called the "DM" model, it provides all the major advantages of the U.S. metered mail system, including faster handling and dispatch in the postoffice, where metered mail needs no postmarking or canceling and therefore can often catch earlier outgoing mail trains and planes. Pitney - Bowes, Inc., Stamford, Conn.

NEW, SELF-ADHESIVE PIPE MARKERS FEATURE FAST, ACCURATE IDENTIFICATION OF PIPING SYSTEMS



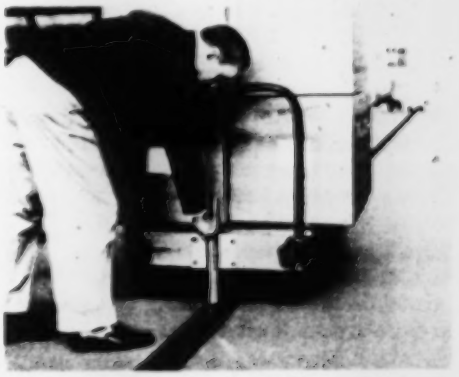
New self-adhesive "QUICK-LABEL" Pipe Markers for fast accurate identification of materials carried in pipes are announced in 4-page folder released by W.H. Brady Co., Milwaukee, Wis. The Markers conform to American Standards Association Standard #A13, "Identification of Piping Systems", compiled by ASA under the sponsorship of the National Safety Council and American Society of Mechanical Engineers. Each Marker is 2-1/4" wide by 9" long and comes mounted on a card 2-3/4" by 9".

ASA Standard #A13 establishes 5 basic background colors for classifying the major types of materials carried in pipes, with the names of the specific material in the pipe superimposed on the proper background color. The pipe markers are printed with the names of the materials in large black letters on the correct ASA background colors. The manufacturer claims the labels can be read up to 75 feet in illumination provided by a flashlight and that anyone who can read knows exactly what is in pipes marked with QUIK-LABELS.

Brady Pipe Markers are designed to replace hand painting and stenciling of pipes. Weather and water-proof, they stick without moistening to bare or covered pipes. Each card is equipped with a Starter-strip which automatically releases part of the label for fast application to the pipe to be marked. W. H. Brady Co., Milwaukee, Wis.

WEBB "TOWVEYOR"

FLOOR TYPE TOW CONVEYOR



The Webb "Towveyor" is a continuous chain conveyor with the chain running in a steel slot below the floor.

A simple towing pin device is bolted to the end of the standard four-wheel or trailer. Standard two-wheel trucks may be used with a dolly.

Trucks are set in motion by dropping the pin into the slot. One of the pusher dogs spaced at suitable intervals on the chain, engages the pin and moves the truck along the Towveyor route.

Disengaging is just as easy--by lifting the pin. Then the truck may be pushed away from the slot, handled as any hand push truck.

In practice, the "Towveyor" chain is looped around the warehouse or other area to be served. Loops can include freight loading and unloading dock, check points, etc. Trucks may be engaged or disengaged at any point. No preset stations are needed. Strength and construction are such that loads may be towed up or down hill if desirable.

No part of the conveyor projects above the floor--there is nothing to interfere with any other traffic.

Ordinary standard shop trucks are recommended--no special attachments are needed except the pin mechanism, which is easily applied. No special operators are needed--the regular warehouse crew handles trucks and conveyor. Trucks do not pile up at any point, but hold spacing as they travel around the circuit. Jeruis B. Webb Co., 8951 Alpine St., Detroit 4, Michigan.

Cont'd on Pg. 18

Industrial Engineering in Transition by R. T. Livingston

One of the most interesting recent developments in the engineering profession has been the growth of industrial engineering. From an almost unrecognized position in the profession and with small student groups in a relatively few institutions the profession has become recognized as a major contributor to the extraordinary productivity of America during the world war. Not only have the student bodies grown to formidable proportions in the institutions where there have been industrial engineering departments, but new departments are being introduced in many places in answer to a definite demand.

The Department of Industrial Engineering was established at Columbia University in 1918. It has grown from the smallest to the largest department in the Engineering School, and its course offering from approximately 75 student points to 195 in the space of two years. It is to be noted that this includes graduate as well as undergraduate courses. Believing that this is a phenomenon of real importance and worth of study, the Department of Industrial Engineering and Management has been carrying on a theoretical and practical study by its staff, certain research assistants and graduate students over the past two years. This article is the first result of these studies to appear. As various phases are completed, other articles will appear in the Journal.

There are many ways that studies can and should be made; perhaps the most obvious one is by means of questionnaires to discover what industry "calls" industrial engineering. In other words, what are the jobs that a graduate in industrial engineering can reasonably hope to be considered for upon graduation. While it is believed that such studies are of interest, it is not believed that they are truly definitive. What industry defines as industrial engineering may be a good measure of what industrial engineering is (although there is great variation in industry), but it does not tell what industrial engineering will be. Industrial engineering is in the process of a great and rapid change; a change from an art to the technique which it now is, and then to the professional science which it will be. What industrial engineering will be depends upon what the industrial engineering schools teach, and more especially, upon what the recent graduates practice, and how successful they are in impressing their abilities upon the profession and industry during the next few years.

Another method of making a study is to carefully analyze the profession and its requirements and to attempt by classification to set up a logical and coherent body of disciplines which will meet the requirements which have been set up for the profession. As far as the ultimate future is concerned, there is the proper engineering approach, but it is not a matter which can be accomplished in a short time and even such a study requires a starting point. That starting point is the "status quo"; what are the schools teaching today and how do these teachings compare with one another and with the obvious professional needs? This report attempts to answer the foregoing questions.

A study has been made of 24 industrial engineering curricula, 7 of which were options in mechanical engineering and 17 of which granted the industrial engineering degree. These schools were in the accredited list of the E.C.P.D. There are other schools which were not included at this point in the study, some because they had not yet become accredited, others because they were so young that full details of the curricula were not available, and still others because course descriptions did not permit adequate comparison. For purposes of comparison, all courses were converted to the Columbia University system, which is 1 point for one 50 minute lecture per week for a 4-month semester or for one three-hour laboratory or computation period.

The accompanying table presents the percentage distribution of points in the various industrial engineering curricula by five major classifications; basic science, basic engineerings, industrial engineering, business and the humanities or general educational courses. There is naturally a problem of classification especially as between industrial engineering and mechanical engineering and industrial engineering and business. This table indicates clearly that there is a real difference between the curricula depending upon whether industrial engineering is a separate department or an option in mechanical engineering; in the latter case there are about ten points more in basic engineering (invariably mechanical engineering and usually machine design and similar courses) and similarly less courses in industrial engineering and business. The industrial engineer invariably has a heavier load in economics, marketing and similar subjects. The first conclusion to be drawn is that the industrial engineering option in mechanical engineering is probably a course in production engineering while the regular industrial engineering course is less narrowly limited.

There is not much difference in the offerings in basic science. It is clear that the industrial engineer receives

(Cont'd next page)

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(Cont'd from page 14)

substantially the same basic training in mathematics, physics and chemistry as do students of other branches of engineering. The only question to be raised at this point is whether the industrial engineer uses these basic sciences in his industrial engineering subjects or whether they are only used as prerequisites in his courses in basic engineering.

The difference between the independent industrial engineering curriculum and that where it is an option in mechanical engineering is most clearly shown in the comparison of the mechanical engineering point totals. For the industrial engineering option in mechanical enginnering, the average number of mechanical engineering points is 26 out of a total of 43 basic engineering points, while the regular industrial engineers take 12 mechanical engineering points out of a total of 30 basic engineering points. One of the most interesting things shown is the almost complete absence of chemical engineering, a matter which deserves some consideration. With the chemical processes occupying such an important place in our industrial economy, it would seem of importance that the industrial engineer should be at least familiar with the basic processes and operations of chemical engineering.

In the field of business, a course in accounting is everywhere required as is generally a course in finance and another in law. There is a great deal of variation in who gives such courses as applies economics, personnel and cost accounting, to name a few. Whether they are offered in the business department or by the industrial engineering department is probably largely a matter of history of the relative dates of establishment and reputation of the two departments. It is believed that except for accounting, finance and law, such courses are best taught for engineers by engineers.

The industrial engineering subjects generally offered may be divided into four broadclasses: (1) Organization and management and production, (2) Economics and costs, (3) Statistics, and (4) Personnel. There is an increasing tendency to divide the field of organization and management from the general field of production. In most cases there was and in many cases still is, a general course which covers the whole field -- usually called industrial management. Without exception however, time and motion study and methods study is taught separately, with perhaps separate courses in production control and tool engineering or production method s. There is a great deal of difference as to the question of engineering economics and costs, where this subject is not taught by the industrial engineering department there is often additional course content in business.

As far as the humanities are concerned, there is great variation as to required points and as to subject matter. No fundamental conclusions can be derived at this point other than to point out that ther e is more stress on the ability to write reports and to present one's ideas coherently in the industrial engineering curricula than in the case of the other branches of engineering.

Other studies have been, and no doubt still are being, carried on; two especially have come to the writer's attention which were presented at the Convention of the American Society of Engineering Education at the Rensselaer Polytechnic Institute, June 1949; "What's New in Industrial Engineering Curricula" by Everett Laitala, Associate Professor of Mechanical Engineering, University of Illinois, and "Industrial Engineering-What Is It?" by F. H. Thomas, Professor and Head Department of Industrial Engineering, University of Buffalo.

If other studies are in preparation the author would appreciate information. This is an important subject and there is so much to be done that duplication of effort must be avoided.

(Professor Livingston's Table Will be Found on Page 2)

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DANGER!

SEE LETTER ON PAGE 5

Army and Navy Appropriations Act, H. R. 4146 was passed by the House in April, 1949 with no timestudy or incentive restrictions applying to any part of the government.

But a Senate Sub-committee on Armed Services in proposing to amend the Act as Section 630 with a much more restrictive clause than was in there formerly. The clause is intended to legally prohibit efficiency among Government employees who would include, of course, most all of us in time of war. The proposed Amendment Section 630 is as follows:

"No part of the appropriations made in this Act shall be available for contracts with any person, firm, or corporation to make or cause to be made with a stop watch or other time-measuring device a time study of any job of any employee; no part of the appropriations made in this Act shall be available for the salary or pay of any officer, manager, superintendent, foreman, or other person or persons having charge of the work of any employee of the United States Government while making or causing to be made with a stop watch or other time-measuring device a time study of any job of any such employee between the starting and completion thereof, or of the movements of any such employee while engaged upon such work; nor shall any part of the appropriations made in this Act be available to pay any premiums or bonus or cash reward to any employee in addition to his regular wages, except for suggestions resulting in improvements or economy in the operation of any Government plant; . . . ."

(Cont'd from page 12)

or more student organizations and then take an active part in them. They will yield a handsome return on the time and effort invested. It is a pleasure to see so many members of the Student Chapters of the American Institute of Industrial Engineers and the Ohio Society of Professional Engineers here tonight.

I am proud of my association with both organizations because they are setting a fine example of the proper relation between a technical and a professional society. The organization of the Medical and Legal professions is somewhat different from our own. The Medical Profession for example is represented by one over-all society. The American Medical Association. Within its framework are many technical groups such as psychiatric, obstetrical, etc. In the case of engineering, most of the technical societies were founded first to keep members of a particular branch informed of the latest developments in that field. The professional society was found later but today the National Society of Professional Engineers with over 19,000 members is larger than most of the technical groups. It has only been in recent years that the need for one organization to speak for all engineers was fully appreciated.

As a member of the City Plan Board of my home community, I have had occasion to observe the operation of zoning laws and restrictions in protecting the property values in business and residential neighborhoods. The neighborhood in which we have erected our professional houses needs similar protection. This is provided by engineers registration acts now in force in all forty-eight states and the territories of the United States. These laws prevent the shack of a shyster being built next to the residence of a properly qualified man and thus protect society from the dangers of incompetent practice.

The building of a good neighborhood for your engineering career has not taken place overnight. Our registration law in Ohio was passed just 15 years ago and has been improved by amendment several times since. There are now some 16,000 registered engineers practicing in the state as compared to 12,000 physicians and 14,000 lawyers. However, almost 100 percent of the licensed physicians and practicing lawyers are members of their respective professional societies whereas only one fifth of the registered engineers are members of the Ohio Society of Professional Engineers.

Engineers are just as apathetic in regard to public affairs as they are to their profession. The engineers on school boards, civic associations, committees for cultural improvement, etc. are few in number. Look at our friends in other professions and you will find them very active. Our Chamber of Commerce has a slogan, "Service is the rent we pay for space occupied in our community."

Too many engineers still do not realize that the value of their individual career houses in the community of society is to a large extent determined by the value of their neighborhood, the engineering profession as a whole. You have made the major investment of your life in your technical training but by all means spend a little additional time, effort and money required to add the polish and refinement to improving your neighborhood, the engineering profession.

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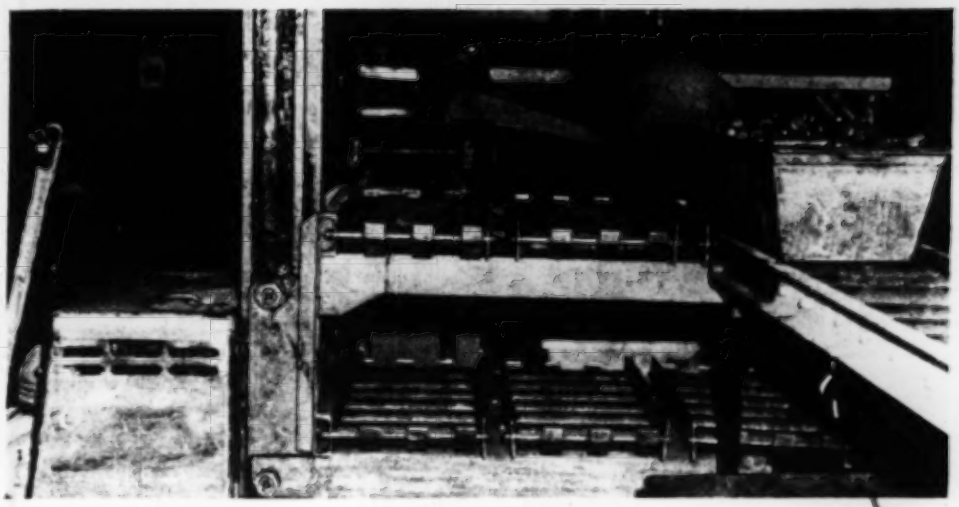


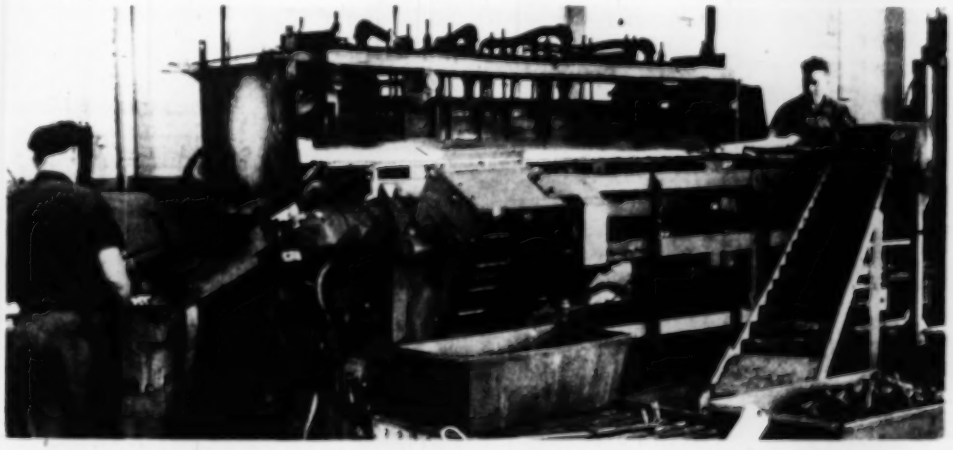
A view showing the battery powered high lift truck delivering parts to a stationary roller section.

length as to accommodate a sufficient number of pans to last the operator for the time required for the battery powered high lift truck to make its rounds. The accompanying illustrations show this truck in use as described.

Several special handling devices were designed to be used in this system. At the furnace for heating pins for hot forging, the operator sits on an elevated platform, and it is necessary to deliver parts to him at working height. This is accomplished by means of an air hoist shown in the accompanying illustration, provided with a roller section and an escapement mechanism. An apron conveyor is provided to bring the hot forging from under the forging machine and to discharge them into a tote pan at conveyor height. Other devices include air operated gates, dumpers, skip hoists, and scale sections for weigh-counting parts while on the conveyor.

As mentioned previously, the variety of size, quantity and quality of parts makes true continuous handling impractical if not impossible in this plant. An engineering analysis of the problem, however, yielded a system that, while not continuous, adheres closely to continuous handling principles. This plant has been operating for some time under this system which has proven to be satisfactory. Economies have developed both in reduced handling and in reduction of work in process. Also, there has been a big improvement in housekeeping with a resultant improvement in worker morale. This has improved product quality and reduced scrap losses.

Although, as stated at the outset, no two plants have identical problems, it is undoubtedly true that there are more plants with semi-continuous or intermittent type operations than plants where a completely continuous layout can be applied. Therefore, it is hoped that this account of an actual solution of material handling problems in a semi-repetitive plant may be helpful to other industrial engineers.



A specially designed conveyor brings the hot forged pins from the pit and delivers them into a tote pan at conveyor height. Note the roller section used to deliver empty pans to the loading point.

RECOMMENDED FOR READING

"A Proposal for the Improvement of Time Study," L. E. Davis, Assistant Professor of Mechanical Engineering, University of California, Berkeley, Cal., Mechanical Engineering, May 1949.

"Shop Participation Guarantees Successful Methods Program," C. H. Hughes, Methods Engineer, Glenn L. Martin Co., Baltimore, Md., Factory, May 1949.

"Recording Gage for Control of Quality at the Machine," C. W. Kenney, Quality Control Engineer, Federal Products Corp., Providence, R. I., Factory, May 1949.

"A Study in Effor t Rating," Henry A. Schell, Modern Management, April, 1949.

"Memomotion Study Technique Simplifies Work Analysis," M. E. Mundel, Professor of Industrial Engineering, Purdue Univ., Lafayette, Ind., Factory, June 1949.

"Industrial Engineering - A Survey of Practice in 89 Plants," Ralph M. Barnes, Professor of Industrial Engineering, University of Iowa, Iowa City, Iowa, Factory, June 1949.

"The Small Manufacturing Company as an Opportunity for Engineering Graduates," Crosby Field, President, Plakice Corp., Brooklyn, N. Y., Mechanical Engineering, May 1949.

"Taking Inventory With a Camera," George Carlson, Assistant Controller, Plomb Tool Company, Inc., Los Angeles, Calif., Factory March 1949.

"Why Music Hath Charm - and Profit," George W. Dyson, Machine & Metal Trades High School, New York, N. Y., Plant Engineering, May 1949.

"Using Model fo Teach Process," William B. Halladay, Training Representative, The Atlantic Refining Co., Philadelphia, Pa., Factory, March 1949.

CHAPTER MANUALS

A manual covering the organization and operation of local chapters has been prepared and may be obtained by chapter officers and those interested in working on the formation of chapters by addressing a request to the national headquarters.

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PHIL CARROLL
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MAPLEWOOD, N. J.

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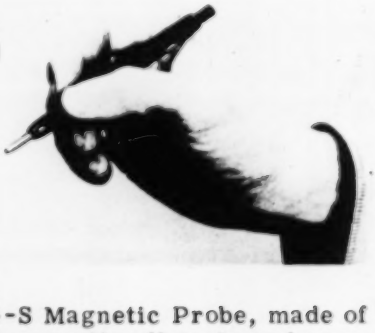
Have You Seen This?

Cont'd from Pg. 13

MACHINE SHOP "LIBRARY"

Technical journals and reading table provide Gulf Research machine shop workers with a "library" which attracts considerable use. Left to right, machinists Edmund Weick, Kurt Nestel, Ralph Strohm and William Jenkins catch up with the newest wrinkles of their trade during lunch hour lull.

POWERFUL, MULTI-PURPOSE MAGNET HELPFUL IN LABORATORY, SHOP AND INFIRMARY



New G-S Magnetic Probe, made of super-magnetic alloy, is no larger than a fountain pen. Point of magnet is extended or retracted from streamlines polished bakelite case by turning end-knob. Strength of magnet can be controlled by amount of extension. Pocket clip is provided for safe, easy carrying.

The G-S Probe is particularly useful for removing steel or iron particles from areas where such foreign matter is harmful, such as the operating area of electrical instruments or delicate mechanisms. It will also conveniently remove sharp particles of steel, iron or nickel from storage bins and retrieve magnetic particles from holes and similar hard-to-reach places.

Assemblers and inspectors find the probe useful to test coat of surfaces for magnetic properties of the undermaterial.

Plant first aid stations use the G-S Probe to remove steel splinters from the eyes or skin of employees. Nurse or doctor can adjust strength of magnet for proper extraction to reduce pain or rupture of tissues. The Probe can be sterilized without harming magnet. General Scientific Equipment Co., Philadelphia 2, Pa.

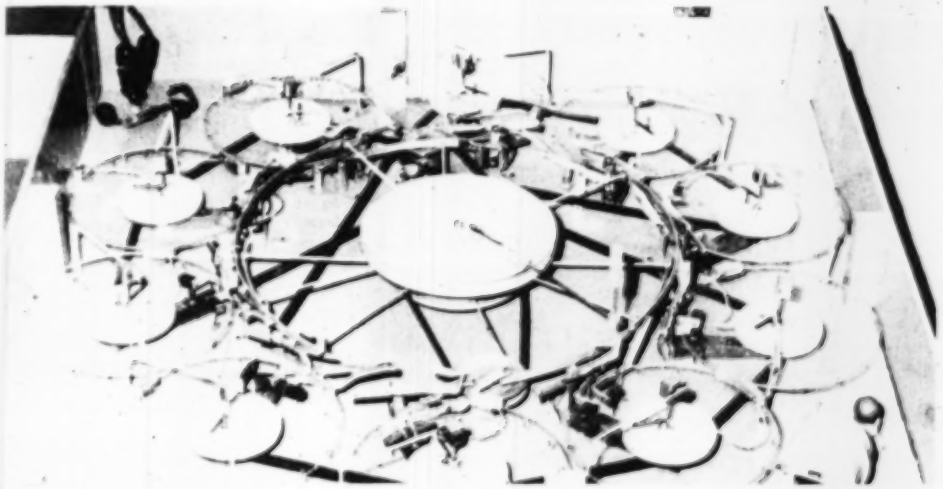
MECHANIZED HAND TRUCK CUTS HANDLING COSTS, PREVENTS DAMAGE AND INJURY

The Tri-Truck, a new, mechanized, three-wheel hand truck, is announced by the Melooz Manufacturing Company. The Tri-Truck is a ruggedly built hard wood and steel general duty hand truck, incorporating a revolutionary telescoping support which adjusts and locks instantly to the correct balance position for any type and weight of load, even with the load on the truck. The Tri-Truck itself balances and supports the load, so that inexperienced, older, or lighter men can do safe, efficient hand trucking work. The Tri-Truck provides leverage which more than doubles the trucker's strength for easy loading, gives safe, sure control for unloading, and makes wheeling the load almost completely effortless. The Tri-Truck keeps the load balanced, even on rough, wet, or slippery surfaces, or if it strikes a floor obstruction, or if a collision occurs with another hand truck. A major cause of personnel injury and costly materials damage is thus virtually eliminated.

Once the Tri-Truck, is loaded, it is set for use as an easel, on the weighing platform, for movement in elevators, without the need for further loading and unloading. Time-consuming rehandling of merchandise, and lost motion are dispensed with. Melooz Manufacturing Co., 4730 Avalon Blvd., Los Angeles 11, Calif.

(Continued from page 11)

very close agreement with the corresponding curve values for groups of four thru ten machines, for both uniform and non-uniform servicing requirements. In no case did the actual interference resulting from a test differ from the corresponding curve value by more than 3%; the average difference was .86%. The actual average interference per machine for all tests involving four thru ten machines was 12.0% and the average interference per machine for the conditions tested, determined through the use of the interference curves, was 12.4%. There were significant differences between the actual interference values and mathematically determined interference values for groups of two and three machines. For this reason, the curves for these limited assignments are not included in the accompanying group of interference curves. The curves of assignments involving ten to one hundred machines have been tested for cone winding and weaving operations in several textile plants in the United States and Canada, and are reported to be reliable. On the basis of the test results and reports from industry, the accompanying interference curves are recommended for general use in determining average interference idleness per machine for assignments involving one operator, in which the running cycles of the machines cannot be coordinated.



A typical experiment under way on the machine-interference computer.

The application of the interference curves can best be illustrated by solving a problem. Assume one operator is to be given the following assignment:

Product	No. Machines	*%S
A	3	14%
B	3	20%
C	4	8%
	10	

*See previous definition of S and %S.

It is desired to determine the average percentage of machine interference idleness per machine when the operator averages 125% productive effort when tending the ten machines.

The total percentage normal work load for this assignment is 3 x 14% + 3 x 20% + 4 x 8% or 134%. The average %S per machine is 134%/10 or 13.4%. If the operator exerts 125% productive effort in servicing the machines, however, the $\%S_E$ becomes (13.4%/1.25)/(12.4%/1.25 + 86.6%) or 11.0%. The average percentage of overall time each of the machines will be non-productive due to machine interference can be determined from the accompanying interference curves.

1. Locate 10 machines on the left vertical "Number of Machines Tended by One Operator" scale.
2. Project horizontally to the 11% "Ave.% Servicing Time Per Machine" curve.
3. At the point of intersection, drop vertically to the "Ave.% Interference Per Machine" scale; the answer for the conditions of this problem is 14% average interference per machine for each of the ten machines.

From the foregoing it is apparent that equitable wage incentive payment for products manufactured in various combinations in multiple requires an accurate, practical means of making allowance for machine interference for individual assignments. A plan for handling this problem will there for be presented in a future issue of the Journal.

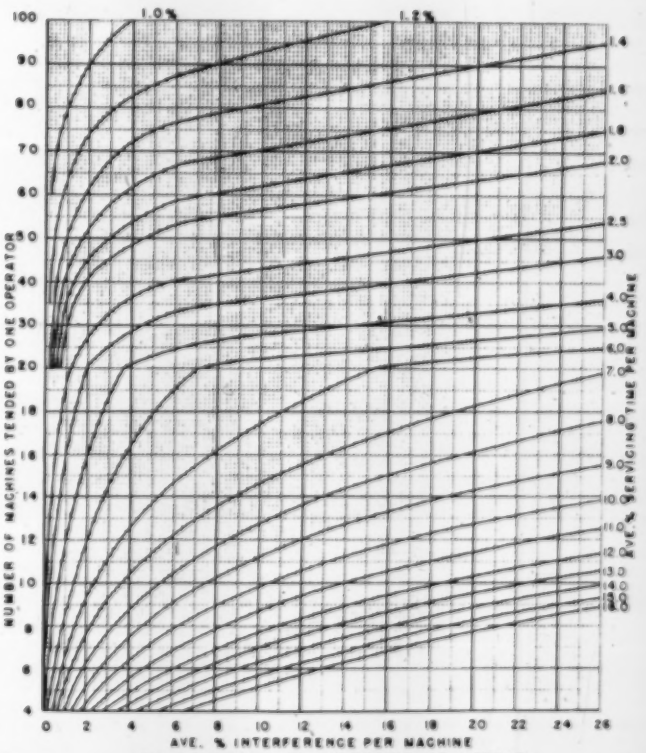


FIGURE 2. MACHINE INTERFERENCE VERSUS SERVICING TIME FOR GROUPS OF 4 TO 100 MACHINES